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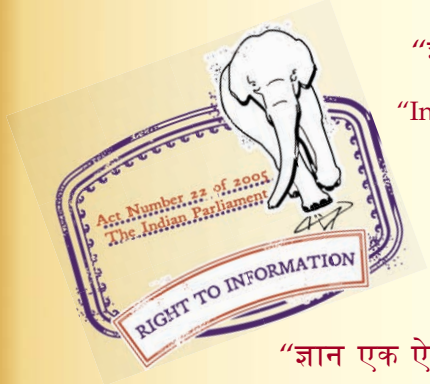
IS 12866 (1989): plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced) [CED 5: Flooring, Wall Finishing and Roofing]



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Indian Standard

PLASTIC TRANSLUCENT SHEETS MADE FROM THERMO-SETTING POLYESTER RESIN (GLASSFIBRE REINFORCED) — SPECIFICATION

Second Reprint OCTOBER 2007
(Including Amendment No 1)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

June 1990

Price Group 5

AMENDMENT NO. 1 APRIL 1999
TO
IS 12866 : 1989 PLASTIC TRANSLUCENT SHEETS MADE FROM THERMO-SETTING POLYESTER RESIN (GLASSFIBRE REINFORCED) — SPECIFICATION

(*Page* 1, *clause* 1.1) — Substitute the following for the existing clause:

"**1.1** This standard specifies dimensions, tolerances, strength and light transmission of glass fibre reinforced translucent plastics sheeting of the profiles specified in IS 277 : 1992 'Specification for galvanized steel sheet (plain and corrugated) (*fifth revision*)', IS 459 1992 'Specification for unreinforced corrugated and semi-corrugated asbestos cement sheets (*third revision*)', and IS 1254 : 1991 'Specification for corrugated aluminium sheet (*third revision*)' for use in roofs "

(*Page* 1, *clause* 2.1) — Substitute the following for the existing clause

'**2.1** The following Indian Standards are necessary adjuncts to the standard.

IS No.	*Title*
277 1992	Galvanized steel sheets (plain and corrugated) (*fifth revision*)
459:1992	Unreinforced corrugated and semi-corrugated asbestos cement sheets (*third revision*)
1254 : 1991	Corrugated aluminium sheet (*third revision*)
6746 1994	Unsaturated polyester resin systems (*first revision*)
11551 1986	Glass fibre chopped strand mat for the reinforcement of polyester resin systems '

(*Page* 1, *clause* 3.3, *fifth line*) — Substitute 'IS 6746 : 1994' *for* 'IS 6746 : 1972'

(CED 5)

Printed at Simco Printing Press, Delhi

Flooring and Plastering Sectional Committee, BDC 5

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards on 25 January 1989, after the draft finalized by the Water Supply and Sanitation Sectional Committee had been approved by the Civil Engineering Division Council.

This standard deals with the quality, performance and overall dimensions of glassfibre reinforced corrugated translucent sheeting for building purposes. It includes sheeting of all profiles given in IS 277 : 1985 'Specification for galvanized steel sheets (plain and corrugated) (*fourth revision*)', IS 459 : 1970 'Specification for unreinforced corrugated and semi corrugated asbestos cement sheets (*second revision*)', and IS 1254 : 1975 'Specification for corrugated aluminium sheet (*second revision*)'. For the preparation of this standard, considerable assistance has been derived from BS 4154 (Part 1) : 1985 'Specification for corrugated plastic translucent sheets made from thermosetting polyester resin (glassfibre reinforced)', issued by the British Standards Institution, U.K.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

PLASTIC TRANSLUCENT SHEETS MADE FROM THERMO-SETTING POLYESTER RESIN (GLASSFIBRE REINFORCED) — SPECIFICATION

1 SCOPE

1.1 This standard specifies dimensions, tolerances, strength and light transmission of glassfibre reinforced translucent plastics sheeting of the profiles specified in IS 277 : 1985 'Specification for galvanized steel sheet (plain and corrugated) (*fourth revis ion*), IS 459 : 1970 'Specification for unreinforced corrugated and semi corrugated asbestos cement sheets (*second revision*)' and IS 1254 : 1975 'Specification for corrugated aluminium sheet (*second revision*)' for use in roofs.

1.2 The recommended temperature range over which the sheets can be used as roof lights or for glazing should be from − 20 to +60°C.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
277 : 1965	Galvanized steel sheets (plain and corrugated) (*fourth revision*)
459 : 1970	Unreinforced corrugated and semi corrugated asbestos cement sheets (*second revision*)
1254 : 1975	Corrugated aluminium sheet (*second revision*)
6746 : 1972	Unsaturated polyester resin systems for low pressure fibre reinforced plastics
11551 : 1986	Glass fibre chopped strand mat for the reinforcement of polyester resin system

3 MATERIAL

3.1 The material shall be composed of a thermo-setting styranated or acrylated polyester resin system reinforced with glassfibre. This system may include curing agents, catalysts and light stabilizers. Fire retardant grade of resin and colouring matter may be used only in special cases as agreed to between the purchaser and the manufacturer.

3.2 The glassfibre used as reinforcement shall be in the form of chopped strand mat having a highly soluble modified polyester binder in accordance with IS 11551 : 1986 having a density of 450 g/m² and minimum width of 500 mm.

3.3 Special grade of unsaturated polyester resin having a refractive index matching that of the glassfibre (that is 1·53) and conforming to the broad specifications given below shall be used. The methods of testing the resin properties shall be in accordance with IS 6746 : 1972 (Physical data in liquid state):

a) Viscosity at 25°C, in cps (Brooke—field LVF spindle 2 /12 rev per min) : 400 to 500

b) Specific gravity at 20°C : 1 11

c) Acid number, in mg KOH/g : 25 to 30

d) Solids, in percent : 65

4 PROFILES, DIMENSIONS AND TOLERANCES

4.1 Profiles

The profile of the sheet shall match the profiles specified in the appropriate Indian Standard for the particular material as given in Table 1 which will surround the translucent sheets.

4.2 The dimensions of the sheets are given in Table 1.

4.3 Sheets with higher thickness than that specified in Table 1 may be made as agreed between the purchaser and manufacturer.

4.4 For the purpose of measuring thickness, a thickness gauge shall be used and it shall be measured at least at 10 random points on all the four sides and the average value shall be taken.

4.5 The depth of each of the corrugations shall be measured on the smooth side and the maximum deviation in any of the cases measured, shall not exceed the limits specified in Table 1.

4.6 For the determining the pitch of the corrugation, total length over 6 pitches shall be measured and the length measured over these 6 pitches shall not vary from 6 time the specified pitch by the tolerances given in Table 1.

5 WORKMANSHIP AND FINISH

5.1 The sheets shall have a smooth surface finish on both sides. A resin rich surface on the exposed part of the sheet is necessary to ensure that the sheet has good weathering properties.

5.2 The moulded sheets shall be reasonably free from visible defects, such as, fibre pattern, foreign inclusions, cracks, crazing, die-lines, pin holes, striations, and bubbles over 1·3 mm in diameter.

5.3 Special Finishes

A clear tissue of fibreglass surface mat or polyester mat may be applied to the sheet surface (on the side exposed to weathering) during manufacture to improve resistance to weathering. Alternatively, PVF and polyester cladding films can be bonded to the sheet surface (on the side exposed to weathering) during manufacture to provide excellent weathering and chemical resistance and longer life

6 PERFORMANCE REQUIREMENTS

6.1 Density

The nominal weight of 1·10+0·15 mm thick plain sheet shall be 1·85 kg/ sq m.

6.2 Glass Content

The glass content in the laminate shall not be less than 30 percent when tested in accordance with Annex A.

6.3 Water Absorption

The sheets shall not absorb water in excess of 0·3 percent when tested in accordance with Annex B.

6.4 Hardness (Barcol)

When the sheets are tested with the method given in Annex C, the Barcol hardness shall not increase by more than 30 percent of its initial value.

6.5 Bolt Shear Test

When tested in accordance with Annex D, the arithmetic mean of the loads at which the first tear appears, shall be not less than 375 N. The load at which the first tear appears while testing any one of the specimens, shall be not less than 250 N.

Table 1 Dimension and Tolerances of Glassfibre Reinforced Corrugated Translucent Rooflight Sheets

(*Clauses* 4.1, 4.2, 4.5 *and* 4.6)

All dimensions in millimetres.

Sl No.	Type of Sheet	Profile No.	Depth of Corrugation		Pitch of Corrugation		Overall Width		Effective Width	Minimum Thickness		Length of Sheet	
			D	Tolerance	*P*	Tolerance	*B*	Tolerance	Tolerance	*T*	Tolerance	*A*	Tolerance
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
i)	Corrugated asbestos cement profile in accordance with IS 459 : 1970	1	48	+3 −5	146	+6 −9	1 050	+10 −5	+10 −5	1·1	+0·15	1 750 2 000 2 500 3 000	0·5 percent of length
		2	45	+3 −5	338	+6 −2	1 100	+10 −5	+10 −5				
ii)	Corrugated steel profile in accordance with IS 277 : 1985	3	17·5	±2·5	75	+5	660				+0·15	1 800	0·5 percent of length
		4	12·5	±2·5			810 910 680 830	±25				2 200 2 500 2 800 3 000	
iii)	Corrugated aluminium sheets profile in accordance with IS 1254 : 1975	5	19	—	75	+5	650 800	±25 ±25		1·1	+0 15	1 800 2 400	0·5 percent of length
		6	38	—	125	±5	795	±25				3 000	
		7	38	—	190	±5	830	±25				3 600	

6.6 Load Deflection Test

This test is applicable only to corrugated sheets and flats of curved sheets. When three sheets of 1·10+0·15 mm thickness are tested in the manner described in Annex E, none of the sheets shall rupture although minor cracking around the areas of support or loading shall be permitted. The total load as shown in Table 2 shall produce a deflection of not more than 15 mm (that is, span/70) on any of the sheets.

Table 2 Deflection Under Test Load

(*Clauses* 6 6 *and* E-1.3)

Profile No. in Accordance With Table	Total Load N
(1)	(2)
1	1 100
2	1 100
3	190
4	190
5	190
6	850
7	750

6.7 Light Diffusion

When determined in accordance with Annex F, the gradient constant shall lie within the limits set out in Table 3 for the appropriate class of sheet.

Table 3 *Light Diffusion Gradient Constant G*

Diffusion Classification	Description	Gradient Constant G
(1)	(2)	(3)
I	Clear	Above 0·80
II	Moderately diffusing	0·32 to 0·80
III	Heavily diffusing	0·10 to 0·32
IV	Very heavily diffusing	Below 0·10

6.8 Transmission

When determined in accordance with Annex G, the gradient constant shall lie within the limits set out in Table 4 for the appropriate class of sheet.

Table 4 Minimum Total Light Transmission

Diffusion Classification	Minimum Total Transmission
(1)	(2)
I	80
II	75
III	70
IV	60

The light transmission properties of sheets containing tinted material are dependent upon the degree of colouring required and the minimum total transmission for coloured sheets shall be subject to agreement between the purchaser and the manufacturer.

7 SAMPLING AND NUMBER OF TESTS

7.1 Scale of Sampling

7.1.1 *Lot*

In any consignment, all the sheets of the same type and of the same thickness and manufactured under similar conditions of production shall be grouped together to constitute a lot.

7.1.2 The conformity of the lot to the requirements of this specification shall be ascertained on the basis of tests on the sheets selected from it.

7.1.3 The number of sheets to be selected at random the lot shall be in accordance with Table 5.

Table 5 Sample Size

Lot Size	Sample Size
(1)	(2)
Up to 500	3
501 to 1 000	5
1 001 to 1 500	7
1 501 and above	10

7.2 Number of Tests

7.2.1 All the sheets selected as in **7.1.3** shall be measured for dimensions and examined for visual defects.

7.2.2 On each selected sheet, the tests shall be performed as indicated in 7.

8 TRANSPORT AND STORAGE

8.1 Sheets should be stored on flat clean battens at 1 500 mm centres and should be protected against being blown away. Sheets stored in the open, should always be covered with water-proof cover. Otherwise, entrapped water causes the sheets to lose colour in prolonged exposure to sunlight.

9 MARKING

9.1 Each sheet shall be stamped or marked by any suitable method with the following information.

a) Indication of the source of manufacture, and

b) Year and date of manufacture.

ANNEX A

(*Clause* 6.2)

METHOD OF TEST FOR GLASS CONTENT

A-1 GLASS CONTENT

A-1.1 The glass content in the laminate shall be determined using the following procedure. The specimen is first weighted on analytical balance in a previously weighted, ignited crucible. The specimen is placed in the furnace at a temperature not greater than 343°C. The temperature of the furnace is raised to 565 ± 28°C, at a rate that will not cause blowing or loss of inorganic filler. The specimen and crucible are then ignited at this maximum temperature to constant weight (2-6 hours depending on the thickness) and allowed to cool in a desiccator. The loss in weight shall be determined by weighing the residue:

Glass content, weight (%)

$$= \frac{W_0 - W_1}{W_0} \times 100$$

where

W_1 = loss in weight, and

W_0 = original weight.

ANNEX B

(*Clause* 6.3)

METHOD OF TEST FOR WATER ABSORPTION

B-1 WATER ABSORPTION

B-1.1 Test pieces shall be cut to size 50 × 50 mm area or of diameter 30 mm, the exposed edges of the test pieces shall be coated with resin to prevent inter-laminar attack. The sections of the pieces shall be cleaned, dried for 24 h in air bath at 50 ± 3°C and then allowed to cool in a desiccator. Following this, the pieces shall be weighed immediately with the help of a chemical balance. Next the test pieces shall be immersed in distilled water for 24 h at 27 ± 2°C, taken out, the water wiped out with a piece of dry cloth and then weighed again immediately. The absorption coefficient shall be determined from the following:

$$A = \frac{W_2 - W_1}{W_1} \times 100$$

where

A = absorption coefficient (percent),

W_1 = weight before immersion, and

W_2 = weight after immersion.

ANNEX C

(*Clause* 6.4)

METHOD OF TEST FOR BARCOL HARDNESS

C-1 HARDNESS

C-1.1 With the indentor perpendicular to the test surface, a light hand pressure is exerted against the instrument to drive the spring loaded indentor into the material and the hardness dial reading is taken and recorded after a 10 second interval An average of at least 5 tests shall be used for determining hardness.

ANNEX D

(*Clause* 6.5)

METHOD OF TEST FOR BOLT SHEAR TEST

D-1 BOLT SHEAR TEST

D-1.1 Cut the test specimens 150 × 30 mm, to be as flat as possible depending on the configuration of the sheet, from a sheet with the long dimension of the specimen in the longitudinal direction of the sheet. On the centre line of each specimen, drill two clean holes, the centre being 38 mm from each end of the specimen, using 0·8 mm twist drill, the specimen being fully supported on a wooden backing.

D-1.2 Procedure

Carry out the test at a temperature of 27±2°C. Place the specimen on a tensile testing machine having pins of diameter 6 +0·130 mm. Thread the pins loosely through the holes in the specimen. Place no restraint on the specimen. Apply the tension at a constant rate such that the jaws of the machine extend at 13 mm ± 5 percent per minute until the first tear in the specimen occurs.

D-1.3 Report

Record the tearing load during the test of each specimens. Report:

a) the conditioning, if any previously given to the specimens;

b) the individual test results; and

c) the arithmetic mean of the test results on all six specimens.

ANNEX E

(*Clause* 6.6)

METHOD OF TEST OF LOAD DEFLECTION TEST

E-1 LOAD DEFLECTION TEST

E-1.1 Test Specimens

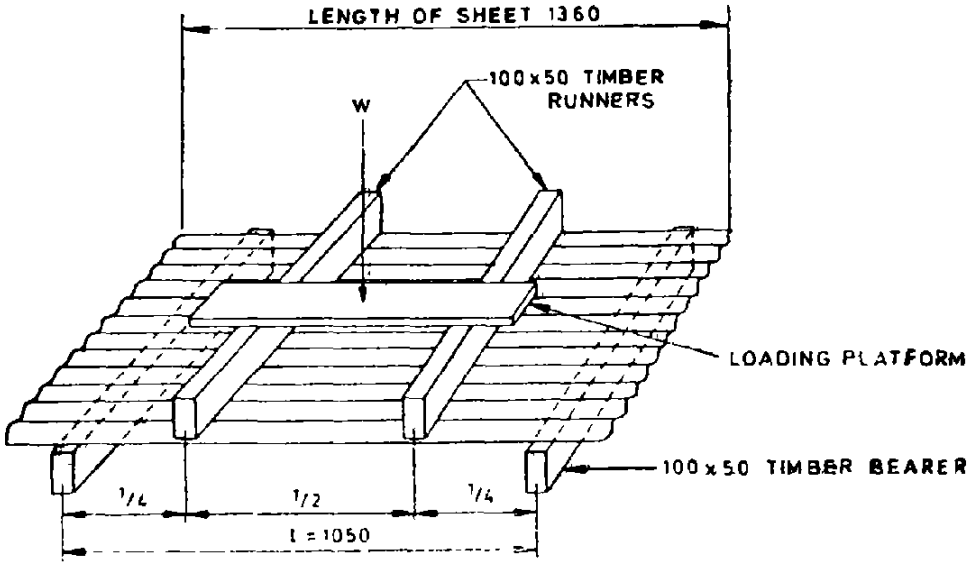
There shall be three test specimens.

E-1.2 Apparatus

The test rig is shown in Fig. 1. The length of the bearers and runners is at least equal to the width of the sheet being tested and the supporting surfaces of the bearers are 50 mm wide, level and parallel with each other. The timber blocks which ensure that initially the load is distributed over the flat areas of the sheets and is not concentrated on the ridge of the corrugations, are parallel and placed (as shown) at one-fourth of the span from the bearers. The load spreader is laid symmetrically over the centres of the runners. The weight of all this timber shall be counted as part of the total load.

E-1.3 Procedure

Apply the load incrementally but as steadily and uniformly as possible, up to the least load specified in Table 2. Maintain the test load for at least 5 minutes and then measure the deflection of the underside of the centre of the corrugation nearest to the centre of the sheet. Record the deflection separately for each test.



All dimensions in millimetres.

FIG. 1 TESTING FOR LOADING AND DEFLECTION TEST ON SHEETS : PROFILES 1, 2, 6, 7 AND 8

ANNEX F

(*Clause* 6.7)

METHOD OF TEST FOR LIGHT DIFFUSION BY SLIT DIFFUSION PHOTOMETER

F-1 LIGHT DIFFUSION TEST

F-1.1 Test for Specimen

F-1.2 Apparatus

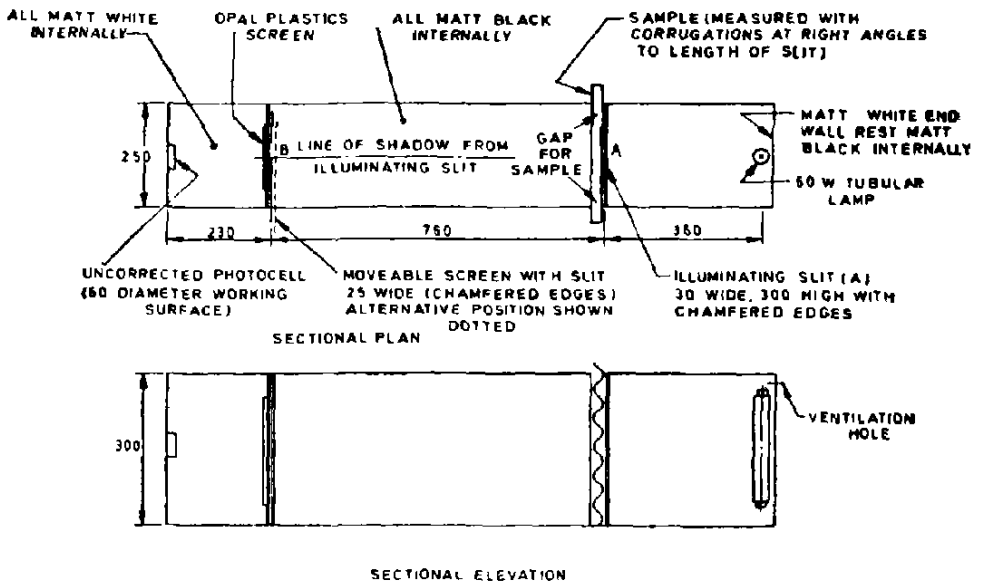
The arrangement of the instrument is indicated in Fig. 2. It consists essentially of a box 1 350 mm long, 250 mm wide and 300 mm high. At one end is the lamp house containing a 60 V, double capped tubular tungsten filament lamp mounted vertically. The wall of the lamp house at the end behind the lamp is painted matt white, but the remaining inside surfaces are matt black.

In the centre of the front wall of the lamp house is a vertical slit (360 mm from the lamp), 300 mm high and 20 mm wide (with chamfered edges) which allows a narrow beam of light with sharp edges to be projected down the length of the box (slit *A*).

An uncorrected selenium rectifier-type photocell (with exposed sensitive surface 60 mm in diameter) is mounted at the opposite end of the box from the lamp house in a compartment 230 mm long, painted matt white internally. In the wall of the photocell compartment facing the lamp is a rectangular hole 1·15 mm wide and 240 mm high; covered with medium opal acrylic plastics material. This fixed aperture is screened from the illumination from slit *A* by a movable screen with a slit 25 mm wide and 240 mm long (slit *B*).

The movable screen is arranged to slide (preferably between two preset stops) so that the slit can be positioned either just inside or just outside the shadow formed by one edge of the slit *A*.

The interior of the box between the two slits is painted matt black, and gaps are left in the sides and top of the box immediately in front (that is on the side away from the lamp) of slit *A* so that a



All dimensions in millimetres.

FIG. 2 SLIT DIFFUSION PHOTOMETER

large sample of diffusing material to be measured can be transversed across the slit. The width of the gap to be left is determined by the amplitude of the largest corrugations on any of the materials to be measured and in this way, a band 300 mm wide around each side of a large sample can be examined.

F-1.3 Procedure

Before making measurements on any sample, it is necessary to set the stops governing the travel of slit *B*, so that at one end of its travel, one of its edges is coincident with the edge of the shadow thrown by slit *A*, and at the shadow. The total amount of travel, allowing sufficient margin for overlap, is about 30 mm.

The actual measurement of diffusion is made by relating readings of a galvanometer connected to the photocell when the sample under test is placed in the slot (with corrugations running horizontally) and the movable screen is set alternately against one or the other of the stops limiting its travel. With the sample immediately in front of slit *A*, and slit *B* in the beam, move the sample past slit *A* (keeping it always entirely covered by the sample) and observe the variations in reading of the galvanometer. Note the maximum and minimum readings and choose a position of the sample so that an average reading is obtained (arithmetic mean of minimum and maximum). Leave the sample in this position and move slit *B* to the opposite end of its travel, and note the galvanometer reading again. The gradient constant *C* is the ratio of the readings with the slit in the two positions minus one. Thus if R_b and R_s are the readings with the slit *B* respectively in the beam and in the shadow.

$$G = \frac{R_b}{R_s} - 1$$

ANNEX G

(Clause 6.8)

G-1 MEASUREMENT OF TOTAL LIGHT TRANSMISSION BY INTEGRATING BOX *PHOTOMETER*

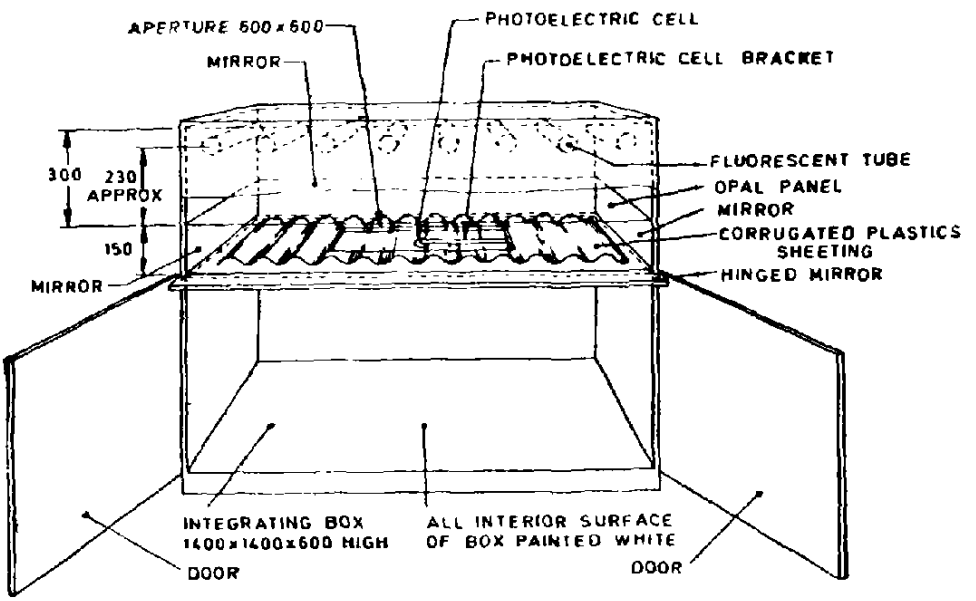
G-1.1 Test for Specimen

G-1.2 Apparatus

The apparatus is constructed as shown in Fig. 3. It consists of a box having internal dimensions of 1 400 × 1 400 × 600 mm high which is painted *matt white inside. In the centre of the top of the* box is an aperture 600 mm square, over which the samples are placed. At the centre of the aperture and level with it is suspended 25 mm diameter consine-corrected photocell facing downwards, and connected to a galvanometer. At 150 mm above the aperture is fixed a diffusing source to represent an 'overcast sky' which consists of eight 1 220 mm 40 W, 'colour matching' fluorescent tubes above a 1 370 *mm* square sheet of medium diffusing opal acrylic plastics material. Mirrors 152 mm wide and 1 370 mm long are fixed below the sky around its periphery between it and the integration box, with one of the mirrors hinged to allow samples to be inserted and removed. In this way, the area of the opal panel is extended to approximate an infinitely large sky.

G-1.3 'Sky' Brightness Distribution

When assembling the apparatus the 'sky' brightness distribution shall be measured using a directional photocell with a 15° field of view which is fixed at the centre of the aperture and can be rotated about an horizontal axis and set at any angle from 0° (horizontal) to 90° in a vertical plane. The photocell is connected to a galvanometer and the readings noted every 10°; from 0 to 90°, in a vertical plane passing through the centre of a side mirror. The readings are repeated with the photocell turned through 90° in a horizontal plane.



All dimensions in millimetres.

FIG. 3 DIAGRAM OF INTEGRATION BOX PHOTOMETER

G-1.4 Effect of Reflection from Sheets Under Test

Due to the small distance between the sample sheet and the opal panel illuminator, some light is bound to be reflected back from the sheet to increase the brightness of the 'sky'. The amount reflected will depend principally on the diffusing power of the material, and the increase of brightness will probably not exceed 4 percent except for the most highly diffusing material.

G-1.5 Procedure

To take measurements, switch on the fluorescent lamps in the 'sky' and allow them to stabilize for at least 15 minutes. During the measurements, keep the voltage supplied to the lamps constant, with a constant voltage transformer, if necessary.

First note the reading (R_1) of the galvanometer without any sample in position, then the reading (R_2) with the sample in place and finally the reading (R_3) without any sample again. There should be very little difference between the first and the third readings, and if this is the case, their mean is used to divide into the reading with the sample in position. Calculate the total light transmission of the specimen by multiply the value of this ratio $\frac{R_2}{\frac{1}{2}(R_1+R_3)}$ by the correction factor $\left(1 - \frac{B'}{100}\right)$, where the value of B' corresponding to the value of 'G' (which should be measured first as given in E-1.3) is determined from the curve in Fig. 4.

G-1.6 Report the mean of the results for the four specimens.

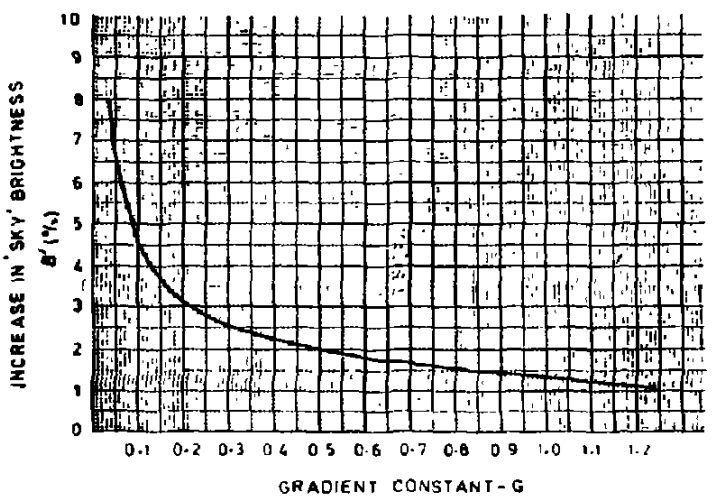


FIG. 4 RELATION BETWEEN GRADIENT CONSTANT AND REFLECTION FROM SHEETS

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